WHAT IS CLAIMED IS:

1. A motor driving apparatus for driving a linear vibration motor having a mover which is reciprocatably provided and a spring member which supports the mover, including:

a mover force vibration unit for making the mover freely vibrate;

a vibration parameter obtaining unit for obtaining a natural vibration parameter that shows natural vibration of the mover on the basis of the free vibration state of the mover;

a spring constant decision unit for deciding a spring constant of the spring member using the obtained natural vibration parameter; and

a mover position calculation unit for calculating the position of the mover using the spring constant that is decided by the spring constant decision unit.

2. The motor driving apparatus as defined in Claim 1 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural frequency detection unit for detecting a natural frequency as the natural vibration parameter of the mover on the

basis of an output from the timing detection unit, and

said spring constant decision unit calculates the spring constant by multiplying the detected natural frequency by a twofold of the ratio of the circumference to the diameter (π), squaring the result of the multiplication, and multiplying the squared value by a mass of the mover.

3. The motor driving apparatus as defined in Claim 1 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural angular frequency detection unit for detecting a natural angular frequency as the natural vibration parameter of the mover on the basis of an output from the timing detection unit, and

said spring constant decision unit calculates the spring constant by squaring the detected natural angular frequency and multiplying the squared natural angular frequency by a mass of the mover.

4. The motor driving apparatus as defined in Claim 1 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the

freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural frequency period detection unit for detecting a natural frequency period as the natural vibration parameter of the mover on the basis of an output from the timing detection unit, and

said spring constant decision unit calculates the spring constant by dividing the detected natural frequency period by a twofold of the ratio of the circumference to the diameter, squaring the result of the division, multiplying the squared value by an inverse of a mass of the mover, and calculating an inverse of the result of the multiplication.

5. A motor driving apparatus for driving a linear vibration motor having a mover which is reciprocatably provided and a spring member which supports the mover, including:

a motor driver for applying a driving voltage to the linear vibration motor;

a current detection unit for detecting a current that is supplied from the motor driver to the linear vibration motor;

a voltage detection unit for detecting a voltage that is applied from the motor driver to the linear vibration motor;

a resonance frequency detection unit for detecting a resonance frequency of the linear vibration motor from the

detected current and the detected voltage;

a spring constant decision unit for deciding a spring constant of the spring member by multiplying the resonance frequency that is detected by the resonance frequency detection unit by a twofold of the ratio of the circumference to the diameter, squaring the result of the multiplication, and multiplying the squared value by a mass of the mover; and

a mover position calculation unit for calculating the position of the mover using the spring constant that is decided by the spring constant decision unit.

6. The motor driving apparatus as defined in any of Claims 1 to 4 wherein

said timing detection unit detects the timing when the freely vibrating mover passes through the prescribed relative position with respect to the reference position of the vibration using an induced voltage that occurs on a coil of the linear vibration motor due to the free vibration of the mover.

7. The motor driving apparatus as defined in any of Claims 1 to 4 wherein

said mover force vibration unit mechanically applies a force to the mover so that the mover freely vibrates.

8. The mover driving apparatus as defined in any of Claims 1

to 4 wherein

said mover force vibration unit temporarily cuts off the current that is supplied to the linear vibration motor so that the mover freely vibrates.

9. The motor driving apparatus as defined in any of Claims 1 to 4 wherein

said mover force vibration unit disconnects a load that is connected to the linear vibration motor so that the mover freely vibrates.

10. The motor driving apparatus as defined in any of Claims 1 to 5 including:

a control unit for setting an operation mode to either a driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an arithmetic mode for calculating the spring constant of the spring member,

said control unit temporarily setting the operation mode to the arithmetic mode before a start of the operation of the load,

said spring constant calculation unit calculating the spring constant in the arithmetic mode before the start of the operation of the load, and

said mover position calculation unit calculating the position of the mover in the driving mode using the spring constant

that has been calculated before the start of the operation of the load.

11. The motor driving apparatus as defined in any of Claims 1 to 5 including:

a control unit for setting an operation mode to either a driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an arithmetic mode for calculating the spring constant of the spring member,

said control unit temporarily setting the operation mode to the arithmetic mode after a completion of the operation of the load,

said spring constant calculation unit calculating the spring constant in the arithmetic mode after the completion of the operation of the load, and

said mover position calculation unit calculating the position of the mover in the driving mode using the spring constant that has been calculated in a recently set arithmetic mode.

12. The motor driving apparatus as defined in any of Claims 1 to 5 including:

a control unit for setting an operation mode to either a driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an

arithmetic mode for calculating the spring constant of the spring member;

a temperature detection unit for detecting a temperature of the linear vibration motor; and

a spring constant estimation unit for estimating the spring constant in a load operating state, wherein

said control unit temporarily sets the operation mode to the arithmetic mode at least one of before a start of the operation of the load and after a completion of the operation of the load,

said spring constant estimation unit,

in the arithmetic mode, derives a relationship between the temperature of the linear vibration motor and the spring constant on the basis of the calculated spring constant and the temperature that is detected by the temperature detection unit when the spring constant is calculated, and

in the driving mode, estimates the spring constant in the load operating state on the basis of the temperature detected by the temperature detection unit using the derived relationship between the temperature and the spring constant, and

said mover position calculation unit calculates the position of the mover in the driving mode using the estimated spring constant.

13. A motor driving apparatus for driving a linear vibration motor having a mover which is reciprocatably provided and a spring

member which supports the mover, including:

a mover force vibration unit for making the mover freely vibrate;

a vibration parameter obtaining unit for obtaining a natural vibration parameter that shows natural vibration of the mover on the basis of the free vibration state of the mover;

a mass/spring ratio decision unit for deciding a mass/spring ratio that is a ratio between a mass of the mover and a spring constant of the spring member using the obtained natural vibration parameter; and

a mover position calculation unit for calculating the position of the mover using the mass/spring ratio that is decided by the mass/spring ratio decision unit.

14. The motor driving apparatus as defined in Claim 13 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural frequency detection unit for detecting a natural frequency as the natural vibration parameter of the mover on the basis of an output from the timing detection unit, and

said mass/spring ratio decision unit decides the mass/spring ratio by multiplying the detected natural frequency

by a twofold of the ratio of the circumference to the diameter (π), squaring the result of the multiplication, and calculating an inverse of the squared value.

15. The motor driving apparatus as defined in Claim 13 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural angular frequency detection unit for detecting a natural angular frequency as the natural vibration parameter of the mover on the basis of an output from the timing detection unit, and

said mass/spring ratio decision unit calculates the mass/spring ratio by squaring the detected natural angular frequency and calculating an inverse of the squared natural angular frequency.

16. The motor driving apparatus as defined in Claim 13 wherein said vibration parameter obtaining unit includes:

a timing detection unit for detecting a timing when the freely vibrating mover passes through a prescribed relative position with respect to a reference position of the vibration; and

a natural frequency period detection unit for detecting a natural frequency period as the natural vibration parameter of the mover on the basis of an output from the timing detection unit, and

said mass/spring ratio decision unit decides the mass/spring ratio by dividing the detected natural frequency period by a twofold of the ratio of the circumference to the diameter, and squaring the result of the division.

17. A motor driving apparatus for driving a linear vibration motor having a mover which is reciprocatably provided and a spring member which supports the mover, including:

a motor driver for applying a driving voltage to the linear vibration motor;

a current detection unit for detecting a current that is supplied from the motor driver to the linear vibration motor;

a voltage detection unit for detecting a voltage that is applied from the motor driver to the linear vibration motor;

a resonance frequency detection unit for detecting a resonance frequency of the linear vibration motor from the detected current and the detected voltage;

a mass/spring ratio decision unit for deciding a mass/spring ratio by multiplying the resonance frequency that is detected by the resonance frequency detection unit by a twofold of the ratio of the circumference to the diameter, squaring the result of the

multiplication, and calculating an inverse of the squared value; and

a mover position calculation unit for calculating the position of the mover using the mass/spring ratio that is decided by the mass/spring ratio decision unit.

18. The motor driving apparatus as defined in any of Claims 13 to 16 wherein

said timing detection unit detects the timing when the freely vibrating mover passes through the prescribed relative position with respect to the reference position of the vibration using an induced voltage that occurs on a coil of the linear vibration motor due to the free vibration of the mover.

19. The motor driving apparatus as defined in any of Claims 13 to 16 wherein

said mover force vibration unit mechanically applies a force to the mover so that the mover freely vibrates.

20. The motor driving apparatus as defined in any of Claims 13 to 16 wherein

said mover force vibration unit temporarily cuts off the current that is supplied to the linear vibration motor so that the mover freely vibrates.

21. The motor driving apparatus as defined in any of Claims 13 to 16 wherein

said mover force vibration unit disconnects a load that is connected to the linear vibration motor so that the mover freely vibrates.

22. The motor driving apparatus as defined in any of Claims 13 to 17 including:

a control unit for setting an operation mode to either a driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an arithmetic mode for calculating the mass/spring ratio,

said control unit temporarily setting the operation mode to the arithmetic mode before a start of the operation of the load,

said mass/spring ratio decision unit deciding the mass/spring ratio in the arithmetic mode before the start of the operation of the load, and

said mover position calculation unit calculating the position of the mover in the driving mode using the mass/spring ratio that has been calculated before the start of the operation of the load.

23. The motor driving apparatus as defined in any of Claims 13 to 17 including:

a control unit for setting an operation mode to either a

driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an arithmetic mode for calculating the mass/spring ratio,

said control unit temporarily setting the operation mode to the arithmetic mode after a completion of the operation of the load,

said mass/spring ratio decision unit deciding the mass/spring ratio in the arithmetic mode after the completion of the operation of the load, and

said mover position calculation unit calculating the position of the mover in the driving mode using the mass/spring ratio that has been calculated in a recently set arithmetic mode.

24. The motor driving apparatus as defined in any of Claims 13 to 17 including:

a control unit for setting an operation mode to either a driving mode for driving the linear vibration motor to operate a load that is connected to the linear vibration motor, or an arithmetic mode for calculating the mass/spring ratio;

a temperature detection unit for detecting a temperature of the linear vibration motor;

a mass/spring ratio estimation unit for estimating the mass/spring ratio in a load operating state, wherein

said control unit temporarily sets the operation mode to the arithmetic mode at least one of before a start of the operation

of the load and after a completion of the operation of the load,

said mass/spring ratio estimation unit,

in the arithmetic mode, derives a relationship between the temperature of the linear vibration motor and the mass/spring ratio on the basis of the calculated mass/spring ratio and the temperature that is detected by the temperature detection unit when the mass/spring ratio is calculated, and

in the driving mode, estimates the mass/spring ratio in the load operating state on the basis of the temperature detected by the temperature detection unit using the derived relationship between the temperature and the mass/spring ratio, and

said mover position calculation unit calculates the position of the mover in the driving mode using the estimated mass/spring ratio.

25. An air conditioner provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving apparatus for driving the linear vibration motor; and

said motor driving apparatus being the motor driving apparatus as defined in any of Claims 1, 5, 13, and 17.

26. A refrigerator provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving apparatus for driving the linear vibration motor; and

said motor driving apparatus being the motor driving apparatus as defined in any of Claims 1, 5, 13, and 17.

27. A cryogenic freezer provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving apparatus for driving the linear vibration motor; and

said motor driving apparatus being the motor driving apparatus as defined in any of Claims 1, 5, 13, and 17.

28. A hot-water supply unit provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder

by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving apparatus for driving the linear vibration motor; and

said motor driving apparatus being the motor driving apparatus as defined in any of Claims 1, 5, 13, and 17.

29. A handy phone provided with a linear vibration motor for generating vibration, and a motor driving apparatus for driving the linear vibration motor, including:

said linear vibration motor having a mover which is reciprocatably provided, and a spring member which supports the mover; and

said motor driving apparatus being the motor driving apparatus as defined in any of Claims 1, 5, 13, and 17.